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IMPROVEMENTS IN CONFECTIONERY MANUFACTURE

The present invention relates to processes for producing fat-based heat-meltable confectionery products, particularly chocolate-type compositions.

Examples of suitable fat-based heat-meltable confectionery products include chocolate-type compositions and fat-based cremes (e.g. biscuit cremes, wafer cremes and pralines).

For the avoidance of doubt, "chocolate-type compositions" includes conventional milk, plain and white chocolate compositions, such compositions in which at least some of the cocoa butter has been removed (i.e. low fat chocolate) and/or replaced by other fats/oils, and/or having at least some of the sugar removed and/or replaced by bulking agents (i.e. low calorie chocolate), including such compositions which by national or international agreement may not be sold as "chocolate". For clarity, such compositions will hereinafter be referred to as chocolate compositions, and any references to "chocolate mixture", "chocolate composition" or "chocolate product" should be construed accordingly.

The pleasurable organoleptic properties of conventional chocolate are to a significant extent due to the fact that the fat (primarily cocoa butter) which forms the continuous phase in chocolate melts quickly and smoothly in the mouth giving a characteristic mouthfeel. This is because cocoa butter softens at approximately 28°C and is generally completely melted at 32 to 35°C. However, such melting presents problems for storage and

distribution in regions where ambient temperatures are high (e.g. 30 to 40°C).

As a result, much research effort has been directed towards the production of so-called "high-temperature tolerant" chocolate products. As used herein, "high-temperature tolerant" in relation to chocolate products, refers to those products which retain their shape at higher temperatures than conventional chocolate. One approach is to replace the cocoa butter partially or completely with higher melting fats. Although such an approach does yield products which maintain their shape at relatively high temperatures, the higher melting fats melt less readily when eaten and leave an undesirable waxy mouthfeel.

A second approach is to develop a structure of non-fat ingredients in the chocolate product which remains rigid when the fat starts to melt, such as a lattice of predominantly sugar particles. A lattice of sugar and/or other hydrophilic materials may be developed by the addition of water to a chocolate mixture. To have a satisfactory mouthfeel and texture, the lattice should dissolve evenly when the chocolate is eaten, and there should be no large aggregates of non-fat ingredients to impart a gritty texture. For success, the prior art focuses on the problem of how to present water to the chocolate mixture. The solutions offered are to form very small water droplets and/or oil/water emulsions. For example, US 5125160 discloses the use of an aqueous foam and WO93/12664 discloses the use of water-in-oil microemulsions, the water being in the form of droplets of size 10 to 1000Å.

Thus, it is an object of a first aspect of the present invention to provide a process for the manufacture of a fat-based heat-meltable confectionery product which exhibits improved properties.

According to the first aspect of the present invention, there is provided a continuous process for the manufacture of a fat-based heat-meltable confectionery product comprising the steps of:-

(i) introducing a fat-based heat-meltable confectionery mixture into a low-shear extruder mixer,

(ii) introducing water into the low-shear extruder mixer,

(iii) mixing the fat-based heat-meltable confectionery mixture and water as they pass through the mixer to form a fat-based heat-meltable confectionery composition, and

(iv) forming the fat-based heat-meltable confectionery composition into the fat-based heat-meltable confectionery product.

The above process enables the confectionery product formed by the process to retain its shape at a higher temperature than a corresponding confectionery product formed from the fat-based heat-meltable confectionery mixture not having undergone the process.

It will be understood that the basis of the first aspect of the present invention resides in the surprising discovery that, contrary to accepted wisdom, the nature of the mixing of the water with the fat-based heat-meltable confectionery mixture is more significant than the form in which water is added. None of the prior art makes any specific recommendation as to the type of mixer to be used. As used herein "low-shear" means a shear of not more than $1000 s^{-1}$.

Preferably, said low-shear extruder mixer is a cavity-transfer type mixer, for example that disclosed in EP 0048590.

The water may be introduced into the mixer by itself, or alternatively as an oil-in-water emulsion, but preferably as a water-in-oil emulsion. If the water is to be added as an emulsion, an emulsifier such as polyglycerol polyricinoleate (PGPR) is preferably included.

Preferably, sufficient water is added such that the fat-based heat-meltable confectionery product has a water content in the range of 1.8 to 3.0% by weight, more preferably in the range of 1.8 to 2.5% by weight.

Preferably, steps (i) and (ii) are effected simultaneously.

Preferably, the fat-based heat-meltable confectionery mixture is a chocolate mixture.

The chocolate mixture may be tempered or untempered. Surprisingly, the process of said first aspect of the present invention does not cause detempering of tempered chocolate mixtures.

Preferably, the water is added to the mixer at 30 to 45°C, and more preferably 40°C.

When the fat-based heat-meltable confectionery mixture is chocolate, it is preferably added to the mixer at 27 to 45°C and, in this case, the mixer is preferably maintained at a temperature of 27 to 45°C. However, in the

case where tempered chocolate is employed, it is preferably added to the mixer at less than 30°C in order to preserve the temper and the mixer is preferably maintained at less than 30°C.

Also according to said first aspect of the present invention, there is provided a fat-based heat-meltable confectionery product prepared in accordance with the process of said first aspect of the present invention.

A related problem is that refrigeration (which may be required even in temperate climates during summer months) hardens conventional chocolate such that it must be held in the mouth for an unacceptably long time in order for it to melt, or it must be chewed. In either event at least some of the pleasure derived from eating chocolate is lost.

European Patent Application No. 0717931 also discloses a chocolate composition suitable for consumption at low temperatures. The fat content of the composition includes at least 40% by weight of fats rich in 2-unsaturated-1,3-disaturated glycerides. Specific fats include fractions of palm, palm kernel and coconut oils having overall melting points from 21 to 30°C. Despite such relatively high melting points, loss of shape at ambient temperatures requires the chocolate to be held in a mould.

Thus, it is an object of a second aspect of the present invention to provide a fat-based heat-meltable confectionery product which, when consumed directly from a refrigerator or freezer, has superior eating characteristics to conventional chocolate consumed in the same way, but which retains its shape at eating temperatures above that of its storage, for example 8 to 50°C.

According to the second aspect of the present invention, there is provided a process for the manufacture of a fat-based heat-meltable confectionery product comprising the steps of:-

(i) mixing a fat-based heat-meltable confectionery mixture whose fat component remains substantially liquid ~~from its melting temperature to a~~ temperature not exceeding 30°C and water in a mixer to produce a fat-based heat-meltable confectionery composition, and

(ii) forming the fat-based heat-meltable confectionery composition into the fat-based heat-meltable confectionery product.

The confectionery mixture will normally contain, in addition to the fat component, at least one added sweetener (e.g. sugar) and may also contain one or more added flavouring ingredients.

The above process enables the product so produced to melt more rapidly when consumed directly from storage at sub-ambient temperature than a corresponding confectionery product formed from the fat-based heat-meltable confectionery mixture not having undergone the process consumed in the same way, and to retain its shape at ambient temperatures.

Preferably said fat component referred to in step (i) is liquid at less than 20°C.

Preferably step (i) is effected by a low-shear extruder mixer, and more preferably, a cavity transfer mixer, for example that disclosed in EP 0048590.

Preferably, said fat component comprises one or more vegetable oils which are more preferably selected from the group consisting of sunflower, maize, groundnut, palm, palm kernel and coconut oils.

Preferably, said fat component oil(s) account(s) for at least 5% by weight of the fat-based heat-meltable confectionery mixture, and more preferably account(s) for between 5% and 55% by weight, and most preferably 15 to 40% by weight.

Also according to the second aspect of the present invention, there is provided a fat-based heat-meltable confectionery product prepared in accordance with the process of said second aspect of the present invention.

Surprisingly, it has been found that such a fat-based heat-meltable confectionery product is capable of retaining its shape at ambient temperatures (e.g. 8 to 50°C) even when the entire fat component consists of a low temperature melting fat such as sunflower oil (melting point -16°C).

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawing which is a schematic representation of an apparatus for performing a process in accordance with the first aspect of the present invention.

Referring to the drawing, an apparatus for performing the process of the present invention comprises a Silverson high-shear mixer 2, first and

second thermostatically controlled holding tanks 4a,4b, a pair of flow-control pumps 6a,6b, a cavity transfer mixer 8 (sold under the tradename CTM under license from the Rubber and Plastics Research Association), a forming station 10 and a cooling tunnel 12. The cavity transfer mixer 8 has first and second inlets 8a,8b and a single outlet 8c.

A flow path exists between the Silverson high shear mixer 2, the first holding tank 4a and the first inlet 8a of the cavity transfer mixer 8. A flow path also exists between the second holding tank 4b and the second inlet 8b of the cavity transfer mixer 8. The outlet 8c of the cavity transfer mixer 8 is connected to a forming station 10 linked by conveyor to the cooling tunnel 12.

In use, an oil/water emulsion (either water-in-oil or oil-in water) is prepared in the Silverson high shear mixer 2 and passed into the first holding tank 4a. A pre-prepared fat-based heat-meltable confectionery mixture is transferred to the second holding tank 4b, with both holding tanks 4a,4b being maintained at the respective desired temperature. The pumps 6a,6b are activated, causing the oil/water emulsion and the fat-based heat-meltable confectionery mixture to be passed via the respective inlets 8a,8b into the cavity transfer mixer 8. The relative flow rates of the pumps 6a,6b are adjusted so that a fat-based heat-meltable confectionery composition having a desired water content will be formed. The oil/water emulsion is mixed into the fat-based heat-meltable confectionery mixture as it passes through the cavity transfer mixer 8 until a substantially homogeneous fat-based heat-meltable confectionery composition emerges from the outlet 8c of the cavity transfer mixer 8. The composition is formed into bars of a desired size and shape. The bars are passed by

conveyor to the cooling tunnel 12 where they are cooled. If the pre-prepared fat-based heat-meltable confectionery mixture is chocolate, it may be tempered before passing into the cavity transfer mixer 8. Alternatively, the chocolate composition formed in the cavity transfer mixer 8 may be tempered after having passed therethrough.

It will be understood that if water rather than an emulsion is to be supplied to the first inlet 8a of the cavity transfer mixer 8, then the Silverson high shear mixer 2 is not required.

In the following Examples, all percentages are weight percentages unless specified otherwise.

Example 1

Water (1%) was added at 40°C to the first inlet 8c of the cavity transfer mixer 8 and a tempered milk chocolate mixture (milk solids 24.1%, sugar (sucrose) 47.4%, cocoa mass 11.6%, cocoa butter 11.3%, vegetable fat 4.9%, emulsifier 0.6% and flavouring 0.1%, with moisture content 1.0%) at 28°C to the second inlet 8b. The chocolate composition which emerged from the outlet 8c of the cavity transfer mixer was slightly more viscous than the chocolate mixture, but was substantially homogeneous and not detempered (as determined by visual inspection).

Comparative Examples 1A and 1B

A tempered chocolate mixture of the same composition as used in Example 1 was stirred at 28°C in a Hobart planetary mixer (Example 1A) and a Winkworth Z-blade mixer (Example 1B). The direct addition of

water (1%) caused in each case the formation of a viscous, detempered, gritty mass, unsuitable for product formation.

The above Examples demonstrate the importance of the choice of mixer for the water to be successfully incorporated into the chocolate mixture, and the fact that, if the cavity transfer mixer is used, even the addition of water itself does not cause detempering of tempered chocolate.

Example 2

An oil-in-water emulsion (47.5% water; 47.5% cocoa butter; 5% soya lecithin) was prepared in the Silverson high-shear mixer 2 and added to the tempered milk chocolate mixture of Example 1 in the manner described in Example 1 to give a final added water content of 1.2%. The chocolate composition emerging from the cavity transfer mixer 8 was formed into bars and cooled.

Example 3

Example 2 was repeated using a water-in-oil emulsion (47.5% water; 47.5% cocoa butter; 5% PGPR) to give a chocolate product with a final added water content of 1.2%. The hardness of the bars, measured as the average force in grams required to compress the chocolate conditioned and held at 35°C by 4mm, is given in Table 1.

Comparative Examples 3A and 3B

Comparative examples 1A and 1B were repeated using the water-in-oil emulsion of Example 3 (a total water content of 2.2%) in place of the

water. The chocolate composition was formed into bars. The hardness values are given in Table 1.

Table 1: Effect of mixer on hardness of chocolate product at 35°C

	Example 3	Example 3A	Example 3B
Hardness (grams force)	1760	305	520

Example 4

Example 3 was repeated using untempered milk chocolate of the same composition as in Example 3 maintained at 40°C.

Thus, it will be clear that the process of the present invention offers distinct advantages in terms of the hardness of the chocolate product. The hardness values reflect the relative abilities of the products to retain their shape at a given temperature. By comparison, the same milk chocolate having no water or water emulsion added has a hardness of <60g. In addition, the texture and mouthfeel of the chocolate of Example 3 was superior to that of Comparative Examples 3A and 3B.

The following Examples are illustrative of the second aspect of the present invention:-

Example 5

Sugar (50 kg), skimmed milk powder (22.6 kg) and low fat cocoa powder (6.1 kg) were premixed and milled at ambient temperature using an

Alpine classifier (mill speed 7000 rpm, classifier speed 3000 rpm) such that 90% of the resultant particles were less than 30 microns in diameter. The above milled powder (4 kg) was conched with butterfat (460 g), sunflower oil (1 kg) and lecithin (54 g) for 4 hours at speed 1 in a Hobart mixer jacketed at 40°C. The resultant mixture was transferred to a Z-blade mixer and a water-in-oil emulsion at 3% of the mix was slowly added at 30°C. The emulsion contained water (47.5%), cocoa butter (47.5%) and PGPR (5.0%). Mixing was continued until the emulsion was dispersed. The chocolate mixture was put into moulds, stored in a refrigerator and demoulded after cooling. Demoulded product had structural integrity at ambient temperature. Chocolate from the refrigerator or the deep freeze melted readily in the mouth to deliver a typical chocolate flavour.

Example 6

2.5 kg milk chocolate crumb (16% fat) was blended with 0.236 kg butterfat and passed through a refiner. 2.68 kg of the refined material was blended in a Hobart mixer with 0.149 kg sunflower oil and 0.016 kg soya lecithin dispersed in cocoa butter for about 2 hours at 40°C until a smooth homogeneous mix was obtained. A water-in-oil emulsion as in Example 1 at 3% of the stirred mix was added and blended. The chocolate was put into moulds and stored in a refrigerator before demoulding. The product was similar in structural integrity at ambient temperature to the product of Example 5.

Example 7

Powder mix as in Example 5 (1.6 kg) was blended in a Hobart mixer at 40°C with butterfat (184 g) and soy lecithin (22 g) followed by blending with groundnut oil (400 g). This blend was fed to the cavity transfer mixer

8 at 40°C while water-in-oil emulsion was pumped to the inlet 8a of the mixer at a rate to give a final moisture content of 2.2% in the chocolate. The chocolate emerging from the mixer was formed into bars and cooled. The product had improved structural integrity at ambient temperature compared with chocolate of Examples 5 and 6, while being at least equal in sensory qualities.

Surprisingly, the chocolates of Examples 5 to 7 retained their structural integrity at ambient temperature, despite the fat component being substantially liquid.